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Serial antigen rapid testing in staff of a large acute hospital

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Point-of-care (lateral flow) assays with an antigen rapid test (ART) for SARS-CoV-2 became commercially available in November 2020 worldwide, as a supplement to real-time PCR (rtPCR).¹ ARTs are self-administered and detect SARS-CoV-2 antigens from anterior nares swabs and return results within minutes. Depending on the kit, ART has a sensitivity of 40·2–74·1% and specificity 93·6–99·8% in asymptomatic individuals, which is inferior to that of rtPCR (86–92% and 99%, respectively).^{2,3} However, ARTs are cheaper, easier to implement at scale, and give faster results than rtPCR testing.³ Various institutions are using ARTs to detect and reduce the transmission of SARS-CoV-2.^{4–6}

Singapore is a densely populated city state of 5·7 million residents. As of late July, 2021, the incidence of SARS-CoV-2 was 23·6 cases per million people per day, with a fully vaccinated rate of 60%. Mandatory mask wearing, limits on the size of social gatherings, thorough contact tracing, and supervised quarantine of all cases and contacts were already in place by this date. Since the start of the COVID-19 pandemic, The National University Hospital, a tertiary academic medical centre employing 8000 clinical staff with a capacity of over 1200 beds, had adhered to a national strategy of fortnightly rtPCR surveillance in all asymptomatic staff, 95% of whom were vaccinated. On July 30, 2021, serial

ART was introduced as a more sustainable, less resource-intensive method of ensuring early identification of COVID-19-positive staff to mitigate transmission to patients at a time when community levels of COVID-19 were increasing.⁷ In addition, symptomatic staff were asked to present immediately for testing. Universal mask wearing for staff had been in place since February, 2020.

Serial ART is an emerging testing strategy and few real-world examples of its use have been published. ARTs performed every 3 days can break chains of transmission of SARS-CoV-2.^{8,9} Although a single ART is not as sensitive or specific as a single rtPCR test, serial testing two or three times a week can outperform a single weekly rtPCR test. The National University Hospital's implementation required all asymptomatic clinical staff to self-administer ART twice a week, routinely. Staff then submitted time-stamped photographs of their ARTs to a co-worker (their ART buddy), which could be reviewed by reporting officers on-demand. Any symptomatic staff were not to make use of this system; rather, they needed to promptly present to the occupational health clinic for rtPCR testing.

Staff read a simple guide based on manufacturer's instructions and electronically signed an acknowledgement stating that they would comply to twice weekly ARTs. Reports from ART buddies and spot audits suggested that staff were engaged and compliant. They

	Advantages	Disadvantages
Diagnostic performance	(1) Lower sensitivity and specificity than rtPCR, mitigated by a strategy of more frequent antigen rapid testing; (2) negative result can predict non-infectiousness; and (3) enables ad hoc quick screening of congregate, vulnerable settings (such as hospitals)	(1) More false positives and false negatives than rtPCR; (2) variable performance among kits; and (3) variable swabbing technique, reading of results among individuals, especially when self-administered
Implementation	(1) Self-administration does not require specially trained staff or rtPCR reagents or machines; (2) almost immediate results; (3) scalable depending on local prevalence and test availability; and (4) reduced barrier to testing as kits can be made easily available to staff for home use	(1) Test kits can be expensive; (2) large number of test kits are required, which might not be readily available in all settings; and (3) poor compliance could be an issue if testing is unsupervised and results are self-reported

rtPCR=real-time PCR.

Table: Advantages and disadvantages of serial testing for SARS-CoV-2 with antigen rapid tests

were asked to report positive results to their reporting officer and occupational health clinic. Positive results lead to a prompt repeat ART and a fast-tracked rtPCR test, while the individual was held in isolation.

Staff identified as having an unprotected contact with a COVID-19-positive individual received a quarantine order or leave of absence. Staff with other, lower risk, exposures would remain at work but, to mitigate further risk, their ART frequency was increased to daily tests.

Between July 30 and Sept 21, 2021, we identified 20 [0.013%] of 156 000 staff with true-positive COVID-19 results, all of whom had been vaccinated and each identification enabled prompt contact tracing and terminal cleaning of exposure sites. To date, we have not detected any in-hospital transmission of SARS-CoV-2. 11 false-positive tests ([0.007%] of 156 000) were also identified, and were negative on repeat ART and rtPCR testing.

In the first 2-week period of implementation, we distributed 65500 ART kits to 8000 staff suggesting that the cost of serial ART testing with our strategy is around US\$100 000 per week. The benefits as compared with fortnightly rtPCR testing are further outlined in the table.³ Frequent testing shortened the window of contact tracing and reduced the number of staff under quarantine. In addition to staff surveillance, we have tailored the use of ART for inpatients who are now being tested on admission and serially through their stay.

Like so many of the emerging tools during the COVID-19 pandemic, diagnostic tests have an evolving role. As of late September, 2021, The National University Hospital has had no clusters of COVID-19 nor any identified transmission between patients and clinical staff through the pandemic. The strategy described in identifying asymptomatic staff with COVID-19 has probably helped to maintain this zero transmission record. Such measures

might need to be continued indefinitely as community transmission increases with the relaxation of pandemic measures.¹⁰ The 95% vaccination rate in our health-care workers means that infections will be mostly mild or asymptomatic, thus routine point of care testing has an important role. High-risk settings with vulnerable patients, such as an acute care hospital, can be protected by serial testing of staff with ARTs.

We declare no competing interests.

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